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EPA Superfund
Record of Decision:

ABEX CORP.
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

RECORD OF DECISION

ABEX CORPORATION SUPERFUND SITE
PORTSMOUTH, VIRGINIA

PREPARED BY
THE U.S. ENVIRONMENTAL PROTECTION AGENCY
AND
THE VIRGINIA DEPARTMENT OF WASTE MANAGEMENT

SEPTEMBER 1992

RECORD OF DECISION

ABEX CORPORATION SITE

DECLARATION

I. SITE NAME AND LOCATION

Abex Corporation Site
Portsmouth, Virginia
Operable Unit One

II. STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the final remedial action selected for Operable Unit One of the Abex Corporation Site (Site), located in Portsmouth, Virginia. This remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. SS 9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedial action and is based on the Administrative Record for this Site. An index of documents for the Administrative Record is included in Appendix A.

The Commonwealth of Virginia concurs on the selected remedy.

III. ASSESSMENT OF THE SITE

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. S 9606, that actual or threatened releases of hazardous substances from this Site, as discussed in Section VI (Summary of Site Risks) of this ROD, if not addressed by implementing the remedial action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

IV. DESCRIPTION OF THE SELECTED REMEDY

The EPA, in consultation with the Virginia Department of Waste Management (VDWM), has selected the following remedial action for the Abex Corporation Site. This ROD addresses the first of two operable units for the Site. This operable unit (OU1) addresses contaminated soil and waste material present within approximately a 700-foot radius of the Abex foundry facility (See Figure 2). The former foundry buildings will also be addressed as part of OU1. The second operable unit (OU2) will further investigate ground water, offsite ecological impacts, and the need for additional remediation of soil beyond the 700-foot radius. The selected remedial action for OU1 addresses the principal threat at the Site by excavating and treating the highly contaminated soils and waste material and by demolishing the buildings associated with the former foundry operation. Treated material, soil containing low levels of contamination that do not require treatment, and building debris will be disposed of offsite in an approved Resource Conservation and Recovery Act (RCRA) landfill.

Response actions began at this Site in 1986 when EPA identified high lead concentrations in the Abex foundry waste within the Abex Lot and in soil of neighboring residential lots. Pursuant to a Consent Order signed with EPA in August of 1986, Abex excavated and removed contaminated soil at varying depths (generally 6 to 12 inches) from residential areas around the Abex Lot, primarily in portions of the Washington Park Housing Project, the Effingham Playground, and around the Seventh Street Homes.

Additional high lead concentrations in soil of residential areas were identified in the Remedial Investigation and Feasibility Study (RI/FS) for OU1 completed in February of 1992. Pursuant to a Unilateral Order issued by EPA in March of 1992, Abex excavated and removed additional contaminated soil to a depth of approximately twelve inches in portions of the Washington Park Housing Project and the Effingham Playground. Excavation and removal of surface soil contamination in the Effingham residential area as called for under the March 1992 Order has not been completed because the home owners in the two-block residential area south of the Effingham Playground have not allowed access to their properties. Residents expressed a desire to know the full extent of cleanup that would be required in this remedial action before allowing a portion of the work to proceed on their properties.

The major components of the selected remedy include:

- Excavation in residential areas of surface soil not addressed under the March 1992 Order and subsurface soil in residential areas, including the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground, where lead concentrations exceed 500 milligrams per kilogram (mg/kg); excavation will extend to the depth of the water table (approximately three to six feet below the surface).

- Excavation of contaminated soil around the foundations and beneath homes and residential units (i.e., Washington Park Housing Project units); geotechnical investigations will be performed during the Remedial Design to determine the appropriate measures to be taken during excavation to maintain the structural integrity of each home or residential unit; residents will be temporarily relocated while excavation is underway in the immediate vicinity of their home or residential unit; sampling of the interior of homes will be performed before, during, and after excavation to ensure that dust control measures have been effective.

- Excavation of soil from non-residential properties, including soil beneath areas currently covered with asphalt (e.g., the Abex and McCready Lots) where lead concentrations either exceed 500 mg/kg in the surface (0 - 12") or exceed 1000 mg/kg in the subsurface (> 12"); excavation of subsurface soil will extend to the depth of the water table (approximately three to six feet below the surface).

- Placement of clean backfill in all excavated areas; restoration of formerly vegetated areas to the conditions existing prior to excavation, to the extent practicable.

- Stabilization by mixing excavated soil and waste material that exhibit toxicity using the Toxicity Characteristic Leaching Procedures (TCLP) with chemicals/reagents; mixing will be contained in above-ground equipment onsite to create a final product that encapsulates and immobilizes lead and other metals; specific chemicals to be used in the process will be determined in a treatability study during the Remedial Design phase of this project; treated material will be tested using TCLP to ensure it no longer exhibits toxic characteristics.

- Transportation of treated soils and waste material and disposal offsite in an approved Resource Conservation and Recovery Act (RCRA) Subtitle D landfill; contaminated soils that do not exhibit toxicity using TCLP may be disposed of in an approved RCRA Subtitle D landfill, without treatment.

- Demolition of all structures associated with the foundry operations; debris exhibiting toxicity using TCLP will be decontaminated in accordance with current Land Disposal Restriction requirements; debris will be disposed of in approved RCRA landfill; decontamination of equipment stored by the current owner in contaminated structures may also be required.

- Air monitoring during onsite activity and implementation of dust control and other necessary abatement actions to prevent exposure of local residents to contamination during the remedial action.

V. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because we do not anticipate that this remedy will result in hazardous substances remaining onsite above health-based cleanup levels (i.e, 500 mg/kg in residential areas, 500 mg/kg in the surface and 1,000 mg/kg in the subsurface soil in non-residential areas), the five-year review will not apply to this action. If hazardous substances are found in concentrations that exceed cleanup levels below the practicable limits of excavation at the water table and, therefore, cannot be excavated, the five-year review will apply to this action.

RECORD OF DECISION

ABEX CORPORATION SITE

DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

The Abex Corporation Site (hereafter referred to as "the Site") is located in the eastern section of Portsmouth, Virginia, approximately 1.2 miles southwest of the confluence of the southern and eastern branches of the Elizabeth River (See Figure 1). The Site encompasses a several block area with numerous parcels of land (See Figure 2). The Site contains the former Abex brass and bronze foundry, which is comprised of five buildings (hereafter referred to as the Holland Property), and associated former waste sand disposal areas (hereafter referred to as the Abex Lot and the McCready Lot). Other areas within the approximate 700-foot Site radius that were found to have contamination associated, at least in part, with the former foundry operation will be addressed in this remedial action.

The location of the Site properties are described as follows: the Holland Property is located in the block bounded on the east by Seventh Street, on the south by Randolph Street, on the west by Green Street, and on the north by Brighton Street; the Abex Lot is located immediately north of the Holland Property; the Washington Park Housing Project is located both northeast of the Holland Property and north of the Abex Lot; the Effingham Playground is located west of the of the Holland Property; private residential properties (hereafter referred to as the Effingham residential area) are located south of the playground and southwest of the Holland Property; a drug rehabilitation center and a small shopping center are located south of the Holland Property; the McCready Lot is located southeast of the Holland property at the northwest intersection of Randolph and Seventh Streets; several row homes are located north of the McCready Lot and immediately east of the Holland Property; and several vacant lots are located east of the Seventh Street. The Washington Park Housing Project, the Effingham Playground, and the Effingham residential area are currently zoned for residential use by the City of Portsmouth. The remaining properties are zoned for commercial and light industrial use.

The Remedial Investigation (RI) for OU1 identified lead as the primary contaminant of concern at the Site. Lead was detected in soils on the Holland Property, under the asphalt-capped Abex and McCready Lots, and in surrounding residential and non-residential areas at levels that pose an actual or potential threat to human health and the environment.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A brass and bronze foundry operated at the Site from 1928 to 1978. The foundry melted used railroad car journal bearings which were over 80% bronze and poured the molten material into sand molds to cast new railroad car bearings. These sand casts eventually became laden with heavy metals, such as lead, antimony, copper, tin, and zinc. During operation, the foundry also produced stack emissions of fine particulate material associated with facility processes.

The National Bearing Metal Corporation purchased the foundry property in May of 1927 and operated the foundry at the Site from 1928 until December of 1944. American Brake Shoe Company bought the foundry in December of 1944 and operated it until May of 1966. At that time, Abex purchased the facility and operated the foundry until it closed in 1978. During Abex's operation of the foundry, waste sand was disposed of in an approximately one acre area immediately north of the foundry building. When the foundry operation closed, Abex graded this disposal area, which is referred to as the Abex Lot, and secured it with a seven foot cyclone fence. Pneumo Abex Corporation, the successor of Abex Corporation, still owns most of the Abex Lot. In 1977, Runnymede Corporation, a real estate investment company, purchased a small parcel of the Abex Lot from Abex. Runnymede still owns this parcel, but no further development has occurred.

In 1984, Holland Investment and Manufacturing Corporation purchased the portion of the Site that contains the foundry building and several smaller associated structures. Holland Investment and Manufacturing Corporation allowed John C. Holland Enterprises, Inc., which is a trash hauling business, to conduct vehicle service and maintenance on the property.

During operation and following closure of the foundry, many of the parcels located nearby have changed ownership and have been redeveloped for other uses. These areas include the Washington Park Housing Project, the drug rehabilitation center, the Effingham Playground, and numerous private residences.

In January of 1983, an EPA contractor visited the Site to observe the conditions at the Abex Lot. No sampling was conducted during this preliminary assessment. EPA contractors returned to the Site in June of 1984 to perform a site inspection and collect several samples from the Abex Lot. Sample results detected high levels of lead (up to 10,400 mg/kg), zinc, copper, tin, and antimony. A sample, which was to serve as an indication of the background concentration of lead in the soil, was collected east of the Site and also had a lead concentration of 2,750 mg/kg.

In April of 1986, EPA collected additional soil samples from the Washington Park Housing Project and other properties adjoining the Abex Site. The analytical results found lead concentrations of up to 12,800 mg/kg in the samples collected. Pursuant to the authority granted in Section 106 of CERCLA, 42 U.S.C. S 9606, EPA entered into a Consent Order with Abex in August of 1986 for the excavation and removal of contaminated soil at varying depths (generally 6 to 12 inches) from certain residential areas around the Abex Lot. The areas to be addressed included portions of the Washington Park Housing Project, the Effingham Playground, and the Seventh Street row homes. All excavated areas were filled with clean soil and revegetated. Abex also paved and fenced the Abex Lot and the McCready Lot.

The analytical data collected at the Site were used to evaluate the relative hazards posed by the Abex Site using EPA's Hazard Ranking System (HRS). EPA uses the HRS to calculate a score for hazardous waste sites based upon the presence of potential and observed hazards. If the final HRS score exceeds 28.5, the site is placed on the National Priorities List (NPL), making it eligible to receive Superfund monies for remedial cleanup. An HRS score of 36.53 was calculated for the Abex Site. As a result, EPA proposed the Abex Site for inclusion on the NPL on June 24, 1988 (53 FR 23988). The Site was placed on the list on August 28, 1990 (55 FR 35502).

On June 2, 1989, pursuant to Section 122 of CERCLA, 42 S U.S.C. 9622, EPA issued Special Notice Letters to Abex Corporation and the Holland Investment and Manufacturing Corporation (hereafter referred to as "Holland Investment") offering them the opportunity to perform the RI/FS for the Site. On October 10, 1989, the VDWM, serving as the lead agency, entered into an Administrative Order on Consent with Abex pursuant to Section 106 of CERCLA, 42 U.S.C. S 9606. Under the terms of the Order, Abex agreed to conduct the RI/FS at the Site to determine the nature and extent of Site contamination and to identify remedial alternatives for Site-related contamination of concern.

Based on the findings of the draft RI/FS report submitted in October of 1991 and the final RI/FS report dated February of 1992, EPA determined that lead contaminated surface soil exceeding 500 mg/kg within the Effinghamresidential area, and at a few additional locations in the Washington Park Housing Project and the Effingham Playground, presented a short-term threat to human health. As a result, pursuant to Section 106 of CERCLA, 42 U.S.C. S9606, EPA issued a Unilateral Administrative Order on March 30, 1992 to Abex requiring Abex to remove such soils from the Site. Abex agreed to perform the removal action and, to date, has excavated and removed additional contaminated surface soil in the Washington Park Housing Project and the Effingham Playground. Removal of soil in the Effingham residential area has been temporarily suspended because the impacted residents have not allowed access to their properties pending issuance of this document.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

EPA has several public participation requirements that are defined in Sections 113(k)(2)(B), 117, and 121(f)(1)(G) of CERCLA, 42 U.S.C. 9613(k)(2)(B), 9617, and SS9621(f)(1)(G), respectively. The documents which EPA used to develop, evaluate, and select a remedial alternative for the Abex Site have been made available to the public in the Administrative Record maintained at the Portsmouth Public Library (Reference Section) and at the EPA, Region III, Philadelphia Office. The Administrative Record is required by Section 113(k)(1) of CERCLA, 42 U.S.C. S9613(K)(1).

The RI/FS Report and the Proposed Plan for the Abex Corporation Site were released to the public in April of 1992. The Proposed Plan described remedial alternatives being considered by EPA and VDWM and identified EPA's preferred alternative at that time. The notice of the availability of the Proposed Plan and the Administrative Record was published in The Virginian-Pilot on April 28, 1992. This notice also invited the public to a meeting on May 7, 1992 to discuss the Proposed Plan with EPA and VDWM. The public was encouraged to review the Proposed Plan and the Administrative Record files and to submit comments on the proposed remedial alternatives to EPA and VDWM. The public comment period was initially scheduled to be open from April 29, 1992 through May 29, 1992, the statutorily required 30-day period. At the request of local citizens, EPA and VDWM extended the public comment period which formally closed on July 10, 1992.

A public meeting was held on May 7, 1992, during the public comment period. At this meeting, representatives from VDWM and EPA answered questions about the Site and discussed the remedial alternatives under consideration, as well as the short-term removal action that was about to proceed. Approximately 30 people, including residents from the impacted area, local government officials, a representative from Pneumo Abex, and VDWM and EPA representatives, attended the public meeting.

EPA and representatives from MaeCorp, Abex's contractor implementing the removal action, visited homes in the Effingham residential area after the public meeting to try to secure access for the removal work. During these visits, EPA also provided additional explanations about the remedial actions presented in the Proposed Plan. After these visits, members of the Madison Ward Civic League requested that EPA and VDWM meet with the Effingham residents to further discuss their concerns.

Representatives from EPA and VDWM met with approximately 30 Effingham residents on May 28, 1992 and June 9, 1992 to discuss the proposed removal and remedial actions and the health effects associated with lead contamination on their properties. During this period, community awareness and concern about the proposed cleanup activities were significantly heightened. On June 25, 1992, representatives from EPA, VDWM, the City of Portsmouth Health Department, and the Agency for Toxic Substances and Disease Registry (ATSDR), met with approximately 60 residents at the community center in the Washington Park Housing Project to provide an additional opportunity for impacted residents to gain information about the health effects of the lead contamination and to discuss the proposed removal and remedial actions. In addition to meetings with the local residents, VDWM and EPA met with local officials on several occasions during this period.

As a result of the June 25, 1992, meeting, the Portsmouth Health Department began offering free blood-lead testing to residents in the impacted area. During July and August of 1992, a total of 546 individuals were tested. Representatives from the Portsmouth Health Department notified families of the test results as they became available and advised families on appropriate follow-up measures, where warranted.

Although the public comment period was closed, EPA held a fifth meeting with the local community at the request of the City of Portsmouth Mayor and City Council. The meeting was held on August 26, 1992. Representatives from the City of Portsmouth Health Department, ATSDR, VDWM, and EPA addressed questions from approximately 150 local residents about health effects of lead contamination and the proposed cleanup of the Site.

Responses to the comments received during the public comment period are included in the Responsiveness Summary, which is part of this ROD. This decision document presents the selected remedial action for the Abex Corporation Site in Portsmouth, Virginia, chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the NCP. The decision for this Site is based on the Administrative Record. The index for the Administrative Record is included in Appendix A of the ROD. This decision is also based upon comments received by VDWM and EPA during the public comment period, which are included in the Administrative Record.

IV. SCOPE AND ROLE OF RESPONSE ACTION

As with many Superfund sites, the problems at the Abex Corporation Site are complex. As a result, EPA and VDWM have organized the work into two operable units (OUs). These OUs are:

- OU1: Contamination in the soil and waste sands on the Holland Property, the Abex Lot, the McCready Lot and in the surrounding properties within an approximate 700-foot radius of the foundry facility

- OU2: Potential contamination of the shallow and deep aquifers, ecological impacts, including further investigation and analysis of surface and sediment quality, and additional soil contamination that may exist beyond the approximate 700-foot radius being addressed in OU1.

The first OU, the subject of this ROD, addresses lead contamination in soil. The primary exposure pathway of concern at this Site is incidental ingestion of soil. Based on results of the EPA's Lead Uptake Biokinetic Model, children are exposed to an unacceptable health risk when the average lead concentrations in surface soil exceeds 400 mg/kg. The purpose of this response is to protect human health and the environment by preventing current or future exposure to the contaminated soil.

As part of OU2, additional RI/FS activity will be performed to fully characterize the nature and extent of ground water contamination. This OU will also include an investigation of additional soil contamination at distances greater than 700 feet from the foundry facility, as well as offsite ecological impacts.

V. SUMMARY OF SITE CHARACTERISTICS

GENERAL OVERVIEW

The Abex Site is located in the urban environment of Portsmouth, Virginia, approximately one-half mile to the west of the south branch of the Elizabeth River. The Site is relatively flat and is approximately 5 to 10 feet above mean sea level. A review of aerial photographs from 1937 reveals extensive surficial drainage surrounding the Site. However, by 1964, drainage was largely confined to Gander Creek, a channelized canal flowing from east to west just north of the Abex Lot. At the present, most drainage occurs through a network of catch basins and storm sewers.

The Abex Site is located in one of the oldest sections of the City of Portsmouth. The area was incorporated into the City's limits in 1784. The U.S. Naval Shipyard, located less than a mile to the southeast, commenced operation in 1767 and presently encompasses about 800 acres. The Portsmouth area experienced rapid growth during World Wars I and II when the Navy expanded its shipyard, hospitals, and docking facilities.

The population in the one-mile radius surrounding the Site varied during the period when the foundry was operating. From 1930 to 1950, the population in this area grew from 27,470 to 30,930. Subsequent to 1950, the population declined to 27,575 in 1960; 19,940 in 1970; and 15,117 in 1980.

The Elizabeth River Basin, which surrounds Norfolk, Portsmouth, and Chesapeake, drains approximately 300 square miles. The river basin is heavily industrialized and receives wastewater discharges from U.S. Naval facilities, heavy industry, major municipal treatment facilities, urban runoff, and boating and docking facilities.

Annual rainfall in the Site area is between 45 and 50 inches. Wind direction for the Portsmouth and the surrounding area is predominantly northnortheast and south-southwest.

Generally interpreted, the former foundry property and the surrounding 700-foot radius study area are underlain by a veneer of undistinguished fill material, sand, and fine grained sediments. Groundwater movement beneath the study area is largely confined to the sand-dominated strata.

Portsmouth lies in the Coastal Plain physiographic province and, in general, is underlain by a thick sequence of unconsolidated sediments consisting primarily of sand, gravel, silt, clay and some shell material. These sediments thicken from west to east in a wedge-like form and are immediately underlain by igneous and metamorphic bedrock. The depositional history of the unconsolidated sediments is complex and has resulted in what is generally an alternating sequence of sand and fine grain sediment layers.

In the vicinity of Portsmouth, large-scale groundwater movement occurs only within the confined aquifer formations. Except for the uppermost aquifer, the Columbia Group, each aquifer is separated from the underlying aquifer by a confining unit. Most of the ground water used in the area for potable purposes is withdrawn from the confined aquifers. At the present time, very little ground water withdrawn from the unconfined Columbia Group aquifer is utilized for potable purposes.

SUMMARY OF RI FINDINGS

The primary focus of the RI was to evaluate possible lead contamination in soil on and around the foundry property. In addition, the RI included a limited investigation of ground water, surface water, and sediments potentially impacted by the Site.

Soil contamination was investigated by sampling and testing over 1,000 samples for lead content. Of these samples, over 550 were also analyzed for fourteen other metals. Soil samples were collected either using a hand auger or through soil borings. A total of 206 locations were sampled using the hand auger. Sample locations were established primarily through use of a 100foot grid system over the 700-foot radius study area. At each location, a minimum of two samples were collected - one at the 0 to 0.5 foot depth and a second at the 1.5 to 2 foot depth. Additional samples were collected to a maximum depth of 3 to 3.5 feet where elevated lead concentrations were observed.

Soil borings ranging in depth from 11 to 26 feet were performed at 34 locations primarily in the Abex Lot and on and around the Holland Property. A minimum of five samples were collected at each location to characterize the stratigraphy of the water table aquifer. The number of samples analyzed varied depending on the location and the conditions encountered. Most analyses were for lead or for the primary pollutant list of fourteen metals.

Sweep samples for dust were also collected from the interior of the foundry building and from the attics of two Seventh Street row homes. A number of the dust and soil samples collected on the Holland Property and in the Abex Lot were analyzed for the complete list of priority pollutants.

The major finding of the RI at the Site was that both surface and subsurface soils are contaminated with lead in residential and non-residential areas. Soil ("floor dirt") and dust throughout the interior of the foundry building on the Holland Property was found to contain lead levels of up to 100,000 mg/kg. Outdoor soil on the Holland Property contains lead levels of up to 58,000 mg/kg within the top two feet. Waste sand beneath the asphalt cap on the Abex Lot has lead concentrations ranging up 24,000 mg/kg. Lead levels of up to 4,750 mg/kg occur within the top two feet of soil under asphalt within the McCready Lot.

Surrounding areas containing lead-contaminated soil associated with the Site include portions of the Washington Park Housing Project, the Effingham Playground, the Effingham residential area, the Seventh Street row homes, the drug rehabilitation center property, and vacant lots east of Seventh Street.

Lead levels of up to 46,500 mg/kg were detected in soil at depths of one to four feet in portions of the Washington Park Housing Project. Subsurface soil in the Effingham Playground contains lead levels up to 5,000 mg/kg. Contaminated surface soil (generally 6 to 12 inches) in both Washington Park and the Effingham Playground were previously excavated and removed by Abex pursuant to a Consent Order signed with EPA in August 1986. A few additional areas in the Washington Park Housing Project and the Effingham Playground were identified during the OU1 investigation as having surface soil contamination above 500 mg/kg. Soil in these areas was excavated and removed by Abex pursuant to a Unilateral Order issued by EPA in March of 1992.

Surface and subsurface soil within the Effingham residential area have lead concentrations of up to 8,000 mg/kg. Additional sampling performed as part of the 1992 removal action detected elevated levels of lead ranging up to 3,739 mg/kg in crawl spaces beneath eleven of sixteen homes sampled in this area.

Soil in lots associated with the Seventh Street row homes contain lead at levels up to 7,000 mg/kg at 0 to 2 feet in depth. Surface soil contamination in the row home lots was previously addressed by Abex under the 1986 Consent Order. Attics of two Seventh Street homes contain dust with lead levels of up to 7,030 mg/kg.

Surface soil within the drug rehabilitation center property contains lead at levels of up to 9,300 mg/kg. Lead has also been detected in surface soil of the vacant lots east of Seventh Street at levels of up to 1,200 mg/kg, with subsurface soils containing lead of up to 6,000 mg/kg.

A limited hydrogeologic investigation was undertaken at the Site to assess the impact of contamination on the surficial aquifer. Four monitoring wells, three piezometers, and numerous soil borings were installed to gain an understanding of the materials and contaminant distribution in the upper aquifer. Two monitoring wells were located in the Abex Lot; one well was located in the McCready Lot; and one well was located immediately north of the Seventh Street row homes. The wells were drilled to approximately fourteen feet below ground surface; the piezometers were drilled to fifteen feet below ground surface. Groundwater was encountered from three to six feet below surface across the Site.

Groundwater data from the Abex property indicates that lead has entered the surficial groundwater in the source area either through migration or through past disposal practices. Elevated concentrations of lead were present in filtered samples collected in one of the monitoring wells in the Abex Lot (MW-1). Lead levels of 31 micrograms per liter (ug/1) and 24 ug/1 were detected during two separate sampling events. EPA recommends a cleanup level of 15 ug/1 for lead in ground water. Filtered samples collected in the other three wells did not exhibit elevated concentrations of lead. The surficial aquifer and the deeper aquifer are not currently used for drinking water supplies in the area of the Site. Further investigation of contamination in the deeper aquifer and the hydraulic relationship between the surface and deeper aquifers will be undertaken as part of OU2.

Surface water and sediment samples were collected from four catch basins within the 700-foot study area. Elevated metal concentrations were observed in both surface water and sediment samples. The significance of the metal concentrations detected and the relationship of these concentrations to the Abex Site is unclear. Further investigation and analysis of surface water and sediment quality at the Site, including potential ecological impacts, will be performed as part of OU2.

VI. SUMMARY OF SITE RISKS

An assessment of the potential risks posed to human health and the environment was completed in accordance with the NCP. Specifically, the baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. It identifies the risks that could exist if no action were taken at the Site. The baseline risk assessment for the Abex Site was completed in February of 1992 and is part of the Administrative Record.

In general, a baseline risk assessment is performed in four steps: (1) data collection and evaluation, (2) the exposure assessment, (3) the toxicity assessment, and (4) risk characterization. This section of the ROD will summarize the findings during each of these steps of the baseline risk assessment for the Abex Site.

IDENTIFICATION OF CONTAMINANTS OF CONCERN

Lead is the contaminant of principal concern at this Site due to its known health effects and its widespread presence in surface and subsurface soil in the residential areas, as well as the foundry properties. Other contaminants present, along with lead, at levels of concern in residential areas include antimony, nickel, tin, copper, and zinc. These contaminants are all known to be present in the waste sands from the foundry operation. Other contaminants present at levels of concern on the Holland Property, the Abex Lot, or the McCready Lot include cadmium, chromium, silver, and polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

The two media of primary concern at this Site are soil and ground water. An overview of the extent of contamination in the soil at the Site is presented in Table 1. The data are presented for the three residential areas the Washington Park Housing Project, the Effingham residential area, and the Seventh Street row homes; for the Effingham Playground; for the foundry properties including the Holland Property, the Abex Lot, and the McCready Lot; and for the vacant lots. The number of samples collected (designated as "n"), the mean (or average) concentrations, and the upper 97.5 percentile confidence limit concentrations are presented in Table 1 for both surface soil (0 12") and subsurface soil (> 12") data. The term "upper 97.5 percentile confidence limit" is a statistical term used in describing how well the data collected reflect actual conditions. There is a 97.5% probability (i.e., 39 times out of 40) that the actual mean concentration for the contaminant of concern listed is below the the upper confidence limit value.

Since lead is relatively immobile in the environment, the ground water investigation in the OU1 RI was limited to four wells in the surficial aquifer. Ground water in the surficial aquifer was found to exceed the EPA's recommended cleanup level for lead in one well which was located in the Abex Lot. The surficial aquifer and the deeper confined aquifer are not currently used for drinking water supply. Further investigation of potential ground water contamination will be performed as part of the OU-2 investigation to assess potential future risk and the need for possible remediation. The discussion of site risks presented below will focus on contamination in the soil media.

HUMAN HEALTH EXPOSURE ASSESSMENT

The purpose of the exposure assessment in the baseline risk assessment is to determine exposure pathways that exist at a site and to quantify the exposure associated with each pathway. An exposure pathway exists if there are: (1) contaminants at a site at levels of concern; (2) individuals that may come in contact with those contaminants; and (3) mechanisms by which contamination can enter the body.

The potentially exposed populations for OU1 consist principally of residents (children and adults) within approximately 700 feet of the foundry who are exposed to soil containing the contaminants of concern discussed above. The risk assessment also considered the potential exposure to adults working in the former foundry building, although this type of exposure is not presently occurring.

Actions at Superfund sites should be based on an estimate of the reasonable maximum exposure expected to occur under both the current and future land-use conditions. The reasonable maximum exposure is defined as the highest exposure that is reasonably expected to occur at a site. The risk assessment for the Abex Site was based on the assumption that current and future land use in the area are not expected to change significantly.

The current land use at the Site is a mixture of residential and commercial/light-industrial. The Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground are currently zoned for residential use (See Figure 3). The Abex Lot, Holland Property, and McCready Lot, the drug rehabilitation center, and the vacant lots are zoned for use as commercial/light-industrial purposes. Future use is expected to remain the same for the residential properties. The Holland Property, the Abex Lot, and the McCready Lot are expected to be used for commercial or light industrial purposes in the future. The drug rehabilitation center is expected to continue operation at its current location. The properties with the greatest uncertainty as to their future use are the vacant lots east of Seventh Street. Most of the vacant lot area is located outside of the 700-foot study area for OU1. The City of Portsmouth had originally planned a 60-acre Port Centre Business Park in this area, however, a GSA project which was the cornerstone of this development was awarded to another city. The City of Portsmouth is currently considering other options for this 60acre parcel located just outside of the 700-foot radius, including construction of a new high school. Routes of exposure considered in the risk assessment include soil ingestion, dermal contact, food ingestion, dust inhalation, inhalation of vapors. These pathways are described briefly below:

Soil ingestion	Eating soil and dust, usually inadvertently and probably arising mostly from the soil being transferred from hand to mouth
Dermal contact	Skin contact with soil and dust
Food ingestion	Eating locally grown foods not thoroughly washed to remove contaminated soil
Dust inhalation	Breathing dust; no industrial dusts are currently being generated through active operations, nor are any expected to be generated in future; dust may come from disturbed contaminated soil in the area
Inhalation of vapors	Breathing vapors from ground water and soil; route of exposure was found to be negligible

To quantitatively evaluate the exposure associated with pathways identified at the Site, assumptions were made concerning the reasonable maximum exposure for an individual living in the impacted area. Table 2 presents the activity pattern for exposed residents and the assumptions made as part of the risk assessment. This table was designed to reflect potential activities for a resident that would result in relatively high exposure to the contaminants of concern in the soil. Different activities were assigned reasonable average weekly times. All activities were assumed to take place for 350 days per year.

As part of the process to quantify exposure, standard assumptions are made concerning factors such as the intake rate for soil ingestion, the ability of soil to adhere to skin, inhalation and consumption rates, the average lifetime, and maximum periods of exposure. Table 3 summarizes the exposure factors used in the risk assessment for the Abex Site.

The final consideration in quantifying exposure is the concentration of the contaminant of concern to be used in the calculation. The risk assessment for the Site used data from soil samples collected in the top six inches to calculate exposure concentrations. Surface soil data was used since residents are exposed to these soils at a much greater frequency than subsurface soil. The mean concentration and the upper 97.5 percentile confidence limit were calculated for each contaminant of concern in each area of the Site, as presented in Table 1. The upper confidence limit values were used to quantify individual exposure.

HUMAN HEALTH TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in an exposed individual. Where possible, the toxicity assessment provides an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. The first step in the process is to determine whether exposure to the contaminant can cause an increase in the incidence of either a cancer-related (carcinogenic) or non-cancer related (noncarcinogenic) adverse health effect. EPA gathers evidence from a variety of sources regarding these health effects including controlled epidemiologic investigations, clinical studies, and experimental animal studies.

The second step in the toxicity assessment is to quantitatively evaluate the health effects associated with the contaminant of concern on the exposed population. For contaminants that are known or suspected of causing cancer, Cancer Slope Factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group in order to estimate the adverse health effect. Carcinogenic effects are measured as the additional risk of an individual contracting cancer as a result of exposure to potentially carcinogenic chemicals. CPFs are multiplied by the estimated exposure rates to provide an upper-bound estimate of the excess lifetime cancer risk associated with that exposure. The term "upper bound" reflects the conservative estimate of the risks and makes underestimation of the actual cancer risk highly unlikely. Table 4 lists the CPFs for the chemicals treated in this risk assessment.

For contaminants that are not known to cause cancer, reference doses (RfDs) have been developed by EPA for quantifying the potential for adverse health effects from exposure. RfDs are

estimates of lifetime daily exposure levels for humans, including sensitive individuals, who are likely to be without an appreciable risk of adverse effects during a lifetime. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated soil) can be compared to the RfD. Table 5 lists values of RfD (for chronic exposure) and RfD (for subchronic exposure), where they are available. The toxicity profiles discussing the possible effects of the contaminants of concern are included at the end of this section.

EPA does not currently recommend using the standard risk assessment methods described thus far for evaluating lead contamination. EPA recommends, and the Abex risk assessment used, the Uptake/Biokinetic (UBK) Model to assess the hazards associated with lead contamination at the Abex Site. The UBK Model estimates a range of blood lead levels for children that can result from the overall exposure to the variety of lead sources in the environment. The model considers possible exposure from air, diet, drinking water, soil/dust, paint chips/dust, and maternal blood lead sources. Table 6 presents the standard assumptions used in the UBK model in the Abex risk assessment. Lead exposure was evaluated for children up to four years old, the group most sensitive to potential adverse health effects from lead.

TOXICITY PROFILES FOR CONTAMINANTS OF CONCERN

Lead is a heavy metal that exists in one of three oxidation states, 0, +2, and +4. Primarily, lead is used in equipment where pliability and corrosion resistance are required, for example, in solder, paints and varnishes, storage batteries, and alloys. Occupational exposure to lead dust and fumes can occur during mining, refining, smelting, and welding. Children exhibiting pica (placing non-food items in the mouth), as well as children exhibiting normal hand-to-mouth activities, who are exposed to lead- contaminated paint chips, dust, or soil can experience elevated blood lead levels, sometimes at elevations significant enough to cause clinical illness. Some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at low blood levels. The fetus may also be impacted by blood levels below 10 micrograms per deciliter (ug/dL). Lead has been classified as a Group B2 probable human carcinogen. Oral exposure to lead salts, primarily phosphates and acetates, has caused kidney tumors in laboratory animals.

(Note: Additional details on the health effects of lead are presented in response to questions in Section I of the Responsiveness Summary.)

TOXICITY PROFILES FOR CONTAMINANTS OF CONCERN (Cont.)

Antimony is a soft metal which is insoluble in water and organic solvents. It is widely used in the production of alloys. Oral exposure to antimony has been shown to cause burning stomach pains, colic, nausea and vomiting in humans. Long-term occupational inhalation exposure is associated with heart disease in both human and laboratory animals. Decreased longevity and altered cholesterol levels have been observed in rats. Antimony has not been tested for carcinogenicity.

Copper is a reddish-brown metal which occurs alone or in ores. It is insoluble in water but soluble in acid. Metallic copper is used as a conductor of electricity and in all gauges of wire for circuitry, as well as in coil and high conductivity tubes. Copper is used in many important alloys, such as brass and bronze. Copper is also used in insecticides, fungicides, catalysts, analytical reagents, and paints. Acute exposure to copper salts may cause eye and skin irritation. Acute industrial exposure to copper may occur from fumes generated during welding copper-containing metals. This type of exposure may cause upper respiratory tract and stomach irritation. The effect of chronic exposure to copper are rarely seen, except in individuals with Wilson's disease. Wilson's disease is a genetic condition where abnormal amounts of copper are absorbed and stored by the body. Chronic exposure to copper may result in anemia. Copper is not classifiable as to human carcinogenicity.

Cadmium is a bluish-white metal. Small amounts of cadmium are found in zinc, copper, and lead ores. Cadmium is insoluble in water but is soluble in acids. Cadmium dust includes dust of various cadmium compounds. Cadmium is used as a protective coating for iron, steel, and copper because it is resistant to corrosion. Cadmium alloys (copper, nickel) may be used as coatings for other materials, welding electrodes, solders, and in pigments and paints. Cadmium is used as an amalgam in dentistry. Various cadmium compounds are used as fungicides and insecticides. Exposure to cadmium can occur through inhalation and ingestion. Short and long-term inhalation exposure to cadmium dust or fumes is associated with swelling of the lung tissue, pain in the chest, difficulty in breathing and emphysema. Long-term ingestion of cadmium is associated with changes and damages to the kidneys in laboratory animals. The EPA has classified cadmium as a Group B1 probable human carcinogen. Cadmium may be associated with an increased risk of prostate and lung cancer in humans occupationally exposed to this contaminant.

Chromium is a heavy metal that generally exists in either a trivalent or hexavalent oxidation state. Hexavalent chromium is soluble and mobile in ground water and surface water. Trivalent chromium is in the reduced form and is generally found adsorbed to soil, therefore, it is less mobile. Hexavalent chromium is used in chrome plating, copper photography, copper stripping, aluminum anodizing, as a catalyst, in organic synthesis, and photography. Exposure to chromium compounds can occur through ingestion, inhalation and skin contact. Hexavalent chromium may have a direct corrosive effect on the skin and may cause upper respiratory distress, headache, fever, and loss of weight. Long-term occupational inhalation exposure to dust and fumes of hexavalent chromium has been shown to cause lung cancer in humans, especially those in the chromate-producing industry. In addition, a number of salts of hexavalent chromium are carcinogenic in rats. The EPA has classified hexavalent chromium as a Group A human carcinogen. Trivalent chromium is an essential nutrient and has low toxicity; however, at high levels, it may cause skin irritation.

Nickel is a hard white, ferromagnetic metal that is a naturally occurring element in the earth's crust and is stable in the atmosphere at ambient temperatures. Nickel forms alloys with a variety of metals including copper, manganese, zinc, chromium and iron. Elemental nickel is used in electroplating and casting operations, magnetic tapes, surgical and dental instruments, nickel-cadmium batteries, and colored ceramics. Occupational exposure to nickel compounds has been associated with an increased incidence of nasal cavity and lung cancers. For this reason, nickel refinery dust has been classified by the EPA as a Group A - Human Carcinogen via the inhalation route of exposure. The most common reaction to nickel exposure is skin sensitization. Nickel and its compounds also irritate the conjunctiva of the eye and the mucous membranes of the upper respiratory tract.

Polychlorinated biphenyls (PCBs) are complex mixtures of the products of the chlorination of biphenyl. The mixtures contain isomers of chlorobiphenyls with different chlorine content. PCBs may contain other chlorinated mixtures (e.g., chlorinated naphthalenes and chlorinated dibenzofurans). PCBs are stable and nonflammable. They are used chiefly in insulation for electric cables and wires. PCBs are persistent in the environment and bioaccumulate in food chains, with possible adverse effects on animals and man. Prolonged skin contact may cause the formation of chloracne which is characterized by blackheads, fat containing cysts and pustules. Irritation of eyes, nose and throat may also occur. Systemic toxic effects are dependent upon the degree of chlorination of the biphenyls. Short and long-term exposure may cause liver damage. PCBs may cause embryo toxicity leading to stillbirth. Some PCBs are carcinogenic in animals. The EPA has classified PCBs as Group B2 probable human carcinogens. Oral exposure to PCBs has been shown to cause liver tumors in laboratory animals.

Polycyclic aromatic hydrocarbons (PAHs) constitute a class of contaminants consisting of substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of organic materials. Their physical, chemical, and biological properties vary with their size and shape. PAHs are persistent in the environment. Benzo (a) pyrene is one of the most common and most hazardous PAH. Some PAHs are classified by the EPA as a Group B2 probablehuman carcinogens. Benzo (a) pyrene is the most potent of the carcinogenic PAHs. Oral exposure to benzo (a) pyrene has been shown to produce stomach tumors in mice and rats and mammary tumors in rats. Dermal exposure to benzo (a) pyrene has been shown to produce skin cancer in mice, rats and rabbits. Oral and inhalation exposure to benzo (a) pyrene has been shown to cause lung tumors in mice and rats. Long-term exposure to PAHs may cause birth defects.

Silver is a white metal insoluble in water and soluble in sulfuric and nitric acids. Alloys or silver (e.g., copper, aluminum, cadmium, lead or antimony) are used in the manufacture of silverware, jewelry, coins, films, in mirrors, as a bactericide for sterilizing water, fruit juices, etc. Some silver compounds are also of medical importance as antiseptics or astringents. Exposure to silver can occur through inhalation of fumes or dust, ingestion of solutions or dust, eye and skin contact. Eye and skin contact with metallic silver may produce local permanent discoloration of the skin similar to tattooing. This process is referred to as argyria. Argyria is characterized by a dark, slategray color pigmentation of the skin. Generalized argyria can also develop through exposure to silver oxides or salts through ingestion and inhalation of dust. Silver is not classifiable as to carcinogenicity.

Tin is a soft, silvery white metal which is insoluble in water. It is used as a protective coating for other metals such as in household utensils, as soft solders, and in the packaging industry. Exposure to tin may occur in mining, smelting, and refining, and in the production and use of tin alloys and solders. Inorganic tin salts are mild skin irritants. Exposure to dust or fumes of inorganic tin is known to cause lung disease. Tin is not classifiable as to human carcinogenicity.

Zinc is a bluish-white metal that is stable in dry air, but becomes covered with a white coating on exposure to moist air. Zinc is present in abundance in the earth's crust. Zinc chloride is used as a wood preservative, in dry battery cells, in oil refining operations, and in the manufacture of dyes, activated carbon, deodorants and disinfecting solutions. Zinc chromate and zinc oxide are used primarily as pigments. Exposure to zinc compounds can cause skin sensitization, irritation of the nose and throat, fever, and fatigue. Zinc is not classifiable as to human carcinogenicity.

HUMAN HEALTH RISK CHARACTERIZATION

The risk characterization section in a risk assessment summarizes the results of the exposure and toxicity assessments to describe the baseline risk for the Site. In general, risk is characterized as being unacceptable when (1) existing levels of contaminants present at the site may cause cancer or some other adverse health effect; (2) there is a route or pathway through which a receptor may be exposed (e.g., ingestion of contaminated soil); and (3) there is a receptor which may be exposed (e.g., a child ingesting soil). For cancer-causing contaminants, risk is measured as the number of additional incidences of cancer that can be expected in an population exposed to that contaminant. For example, one additional incident of cancer estimated to occur in a population of 10,000, as a result of exposure to contamination at a site, would quantitatively be described as a 1 x 10[-4] cancer risk. EPA recommends that remedial actions be taken to address risk greater than a 1 x 10[-4] cancer risk. EPA may recommend action in situations where the risk is in the range of 1 x 10[-4] to 1 x 10[-6] (one additional incident of cancer in a population of 1,000,000).

For noncarcinogenic contaminants, risk is considered unacceptable when the concentration of the contaminant that an individual is exposed to (i.e., the intake rate) exceeds the RfD concentration for that contaminant. The noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ). To assess the overall potential for noncarcinogenic effects posed by more than one contaminant, the HQs are added to determine the Hazard Index (HI). The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposure within a single medium or across media. EPA may recommend action in situations where the HI exceeds one.

Table 7 summarizes the quantitative results of the risk assessment for residents and workers exposed to contaminants of concern other than lead at the Site. In the case of residential exposure, risks to different age groups were determined.

EPA does not recommend characterizing the health effects associated with lead using the risk assessment procedures discussed above. EPA currently believes that the best available approach for characterizing risks associated with lead in residential areas is the UBK Model. The UBK Model was used at the Abex Site to predict the percentage of highly exposed children that would have a level of lead in their blood exceeding 10 ug/dL, the level recommended as safe by the Center for Disease Control (CDC), at various levels of contamination. Based on the exposure assumptions presented earlier, the model predicts that approximately 95 percent of the children exposed to soil/dust with an average lead concentration of 400 mg/kg would have blood lead levels below 10 ug/dL.

The baseline risk assessment for the Abex Site has determined that contamination at the Site currently presents unacceptable risks to residents and would pose unacceptable risks to workers within the former foundry building. The average lead concentration exceeds 400 mg/kg in surface soil in the Effingham residential area, on the Holland Property, and in the vacant lots. Average lead concentrations also exceed 400 mg/kg in subsurface soil in the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, the Holland Property, the Abex Lot, the drug rehabilitation center, and the vacant lots.

The baseline risk assessment also indicates that children between the ages of one and seven and future workers at the former foundry building would be exposed to unacceptable risks associated with other noncarcinogenic contaminants of concern. This is indicated in Table 7 where the total HI values are greater than one. It should be noted, however, that the HI calculations may overestimate the potential for adverse health effects at the Site since not all contaminants of concern induce the same health effect by the same mechanism of action.

The total lifetime cancer risks associated with the Site are 3.0 x 10[-5] for residents (i.e., one additional incident of cancer in an exposed population of 33,333) and 8.97 x 10[-4] for future workers at the former foundry facility (i.e., one additional incident of cancer in an exposed population of 1,115).

FUTURE RISKS ASSOCIATED WITH SUBSURFACE SOIL

The risk assessment that was performed for the Abex Site does not specifically address the issue of human health risks that may exist if contaminated subsurface soil is brought to the surface by future activity. The risk assessment only briefly discusses this subject in conjunction with current and future land use and states that highly contaminated subsurface soils could be brought to the surface if large scale development occurs.

In addition to large scale development, EPA and VDWM have considered other possible mechanisms for exposure to subsurface soils either directly or by the transport of these soils to the surface. Routine activities by property owners or their children that could result in direct contact with subsurface soils include, but are not limited to: gardening of fruits, vegetables and other plants; children playing in soil (e.g. digging holes, making mudpies, etc.); and installing fence posts, decks, and playground equipment. Construction activities that could result in human exposure to contaminated subsurface soil and the recontamination of surface soil include, but are not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of in-ground pools.

EPA and VDWM are unaware of any research or models that can be used as a basis for estimating the potential future exposure of residents to subsurface soil contamination. Since future activities in the residential areas of OU1, unless restricted, could reasonably result in either direct exposure to contaminated subsurface soil or exposure to contaminated soil reintroduced to the surface, EPA and VDWM believe surface and subsurface soil are of equal concern. Since this ROD identifies the final remedial action for contaminated soil in OU1, EPA and VDWM believe a conservative approach to determining the extent of cleanup is appropriate.

ECOLOGICAL RISK

The OU1 RI focused on the area within a 700-foot radius of the foundry which is a predominantly urban area. A formal ecological risk assessment that qualitatively and/or quantitatively appraises the actual or potential effects of the Site on plants and animals was not performed as part of this OU. An investigation of the ecological impacts that may be associated with this Site, particularly with regard to the Elizabeth River and offsite environmental receptors, will be evaluated in OU2.

LEAD CLEANUP LEVELS

After completion of the baseline risk assessment at a site, appropriate cleanup levels are considered during the feasibility study in order to evaluate the effectiveness of the remedial alternatives. For sites dealing withlead contamination, EPA recommends, as a matter of policy (OSWER Directive #9355.4-02), that soil cleanup levels in the range of 500 to 1,000mg/kg lead be used to trigger a remedial action in residential areas. The use of a specific level to trigger an action has proved to be an effective method for implementing cleanup activities. After cleanup has been completed, confirmatory sampling is performed to ensure that unacceptable risks identified in the baseline risk assessment have been addressed. Since other contaminants of concern identified at the Abex Site are found in close association with lead, actions taken to achieve the lead cleanup levels will also be effective in addressing unacceptable risks from these contaminants.

VII. DESCRIPTION OF ALTERNATIVES

Engineering technologies were screened in the FS report to determine which ones could be applied to clean up contamination identified at the Site. The technologies were evaluated based on their effectiveness, cost, and implementability. Those technologies determined to be most appropriate were then developed into remedial alternatives. Table 8 presents the alternatives evaluated in this ROD, their present worth cost, and the time required for implementation. These alternatives are for work to be performed in addition to that already performed under the Removal Action.

COMMON ELEMENTS OF ALL ALTERNATIVES:

Except for Alternative 1, the No-Action Alternative, all of the remedial alternatives include the following common elements:

Demolition of Former Foundry Facility Buildings

All buildings associated with the former foundry operation would be demolished in Alternatives 2-7. <Footnote>1 This represents a change from the Proposed Plan which indicated that building would be decontaminated. Section XI (Documentation of Significant Changes) provides further explanation.</footnote> Building debris would be disposed of offsite in an approved RCRA landfill in accordance with RCRA Land Disposal Restrictions. Equipment maintained within these buildings by the current property owner would have to be removed and may require decontamination.

Solid residuals generated by any decontamination activities would be handled in the same manner as contaminated soil. Any contaminated soil beneath the buildings would be addressed in the same manner as surrounding nonresidential soil on the Holland Property, the Abex Lot, and the McCready Lot.

Soil Excavation, Offsite Disposal, and Temporary Relocation

Soil excavation and offsite soil disposal is required to various extents under all of the alternatives. TCLP testing would be conducted to determine whether excavated soil is a RCRA characteristic hazardous waste. Soil which is determined to be a RCRA hazardous waste would be treated prior to land disposal. Soil which is not a RCRA hazardous waste may still require treatment prior to disposal in a solid waste facility within Virginia or another state. Conventional earth moving equipment would be used to excavate and load the contaminated soil. Contaminated soil beneath homes and residential units may be removed using vacuum-type equipment. Dust suppression measures would be used to ensure that unacceptable releases on air-borne contamination do not occur. All excavated areas would be backfilled with clean fill and revegetated to achieve former conditions, to the extent practicable. Temporary relocation would be provided to residents while excavation is occurring around or beneath their homes or residential units.

Soil Treatment By Stabilization and/or Solidification

Where treatment is included, the treatment would be stabilization by mixing excavated soil and waste materials from the Site that exhibit toxicity using the TCLP test with chemicals/reagents. The mixing would be contained in above-ground equipment onsite to create a final product that encapsulates and immobilizes lead and other metals. Specific chemicals to be used in the process would be determined in a treatability study during the Remedial Design phase of the project. Treated material would be tested using TCLP to ensure it no longer exhibits toxic characteristics.

Discharge of Contaminated Water

Discharge of decontamination water and any other water generated during remedial activities will meet Virginia Pollution Discharge Elimination System (VPDES) requirements developed pursuant to the Federal Clean Water Act, 31 U.S.C. SS1251 et seq., and the Virginia State Water Control Law, Code of Virginia SS 62.1-44.2 et seq.

Air Emissions Monitoring During Remedial Activities

Air will be monitored for both dust and lead levels during the remedial activities to protect the health of onsite workers and the community. Sampling of the interior of homes in the vicinity of excavation will also be performed before, during, and after excavation to assure that there is no significant release of contaminated dust into homes during the remedial activity. Air will be monitored to ensure that the National Emission Standards for Hazardous Air Pollutants (NESHAPs) developed under the Federal Clean Air Act, 40 C.F.R. S 50.12 and 50.6, and the Virginia Regulations for the Control and Abatement of Air Pollution (VRCAAP), VR 0401-0101, are not exceeded.

Transportation, Storage, Treatment and Disposal of Soil and Debris in Conformance with State Requirements

In all cases, transportation, storage, treatment and disposal of soil and debris will be in compliance with applicable with Virginia Hazardous Waste Management Regulations (VHWMR) or Virginia Solid Waste Management Regulations.

DESCRIPTION OF EACH ALTERNATIVE:

A description and the estimated cost of each alternative are summarized below. Present Worth includes an estimate of operation and maintenance (O & M) costs over a thirty (30) year period.

Alternative 1: No Action

Pursuant to the National Contingency Plan (NCP), 40 C.F.R. Section 300.430(e)(6), the "no action" alternative is considered to provide a baseline for comparison to other remedial alternatives. Under this alternative, no action beyond the removal actions would be performed.

Surface soil (0-12" in depth) with lead levels exceeding 500 mg/kg would remain at the drug rehabilitation center property and the vacant lots. Subsurface soil (> 12" in depth) with lead levels exceeding 500 mg/kg would remain in the Washington Park Housing Project, the Effingham Playground, the Effingham residential area, and the Seventh Street row homes. Subsurface soil exceeding 1,000 mg/kg lead would remain at the Abex and McCready Lots, the Holland Property, the drug rehabilitation center property, and in the vacant lots. Certain areas of lead contamination, including the Abex and McCready lots, and areas of the Holland Property, are currently capped and fenced, minimizing exposure to underlying lead at this time. However, these caps would not be permanently maintained under this alternative. This action would not reduce the risks to the public health and the environment outlined in Section VI above.

Since no action is proposed, there are no costs.

Alternative 2: Surface Soil Excavation, Offsite Treatment/Disposal, Capping, and Institutional Controls

Under this alternative, remaining surface soil (0-12" in depth) exceeding 500 mg/kg lead, except soil currently capped, would be excavated. Areas of excavation would include the drug rehabilitation center property, the Effingham Residential area and the vacant lots. The excavated soils would be transported in accordance with RCRA requirements to an approved RCRA Treatment Facility. The soils would be treated at the offsite facility, tested using TCLP to ensure RCRA Land Disposal Restriction requirements are met, and disposed of in an approved RCRA Subtitle D landfill. Excavated areas would be backfilled with clean soil, graded, and revegetated. Institutional land use controls (e.g., deed restrictions) restricting activity below one foot in depth would be required on all properties where lead concentrations in subsurface soil exceed 500 mg/kg in residential area and 1,000 mg/kg in non-residential areas.

Existing caps (i.e., pavement) on the Abex Lot, McCready Lot and the Holland Property would be permanently maintained under this alternative. Institutional controls would be required to control future exposure to the capped soils on these lots.

A CERCLA five-year review would be required under this alternative because hazardous substances would be left onsite. This alternative is designated as Alternative II, Case 1, in the FS and additional information developed in response to public comments.

Estimated Capital Cost:	$ 4,865,430
Estimated O & M Cost:	$ 23,500
Present Worth:	$ 4,888,930
Time to Construct:	12 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 3: Surface and Subsurface Soil Excavation, Offsite Treatment/Disposal

Surface and subsurface soil exceeding 500 mg/kg lead in residential areas, including contaminated soil adjacent to home foundations and beneath homes[3], <Footnote>3 This clarification on the extent of excavation was notincluded in the Proposed Plan. Section XI (Documentation of Significant Changes) provides further discussion.</footnote> would be excavated to the depth of the water table. Since the water table in the project area fluctuates and has been observed at depths from three to six feet below the surface, excavation would occur during the period when the water table is at the seasonally low elevation, to the extent practicable. Geotechnical investigations would be performed during the Remedial Design to determine appropriate construction techniques to be used to maintain the structural integrity of the homes during excavation. Temporary relocation would be provided to residents while excavation is occurring around or beneath their homes or residential units.

In non-residential areas, surface soil (0-12" in depth) exceeding 500 mg/kg lead and subsurface soil (>12" in depth) exceeding 1,000 mg/kg[4] <Footnote>4 The Proposed Plan indicated that subsurface soil in non-residential areas exceeding 500 mg/kg would be excavated, the same as in residential areas. Upon further consideration, EPA and VDWM have determined that 1,000 mg/kg is the appropriate cleanup level for subsurface soil in non -residential areas. Section XI (Documentation of Significant Changes) provides further discussion.</footnote> lead would be excavated to the depth of the water table. To the extent practicable, excavation would occur during the period when the water table is at the seasonally low level.

All excavated areas would be backfilled with clean soil. Formerly vegetated areas would be graded and reestablished to original conditions, to the extent practicable.

The excavated soils would be transported in accordance with RCRA requirements to an approved RCRA Treatment Facility. The soils would be treated at the offsite facility, tested using TCLP to ensure RCRA Land Disposal Restriction requirements are met, and disposed of in an approved RCRA SubtitleD landfill.

Prior to the excavation of contaminated soil on the Abex Lot, the McCready Lot, and the Holland Property, existing asphalt and concrete would be removed and disposed as construction and demolition debris. This alternative is designated as Alternative II, Case 2, in the FS and additional information developed in response to public comments.

Estimated Capital Cost:	$ 37,895,000
Estimated O & M Cost:	$ 0
Present Worth:	$ 37,895,000
Time to Construct:	57 weeks

Alternative 4: Surface and Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated as described under Alternative 3.

Excavated soil and waste materials would be tested using TCLP to determine if it exhibits toxicity. Excavated soil and waste materials not exhibiting toxicity would be transported and disposed offsite in an approved RCRA Subtitle D landfill. Excavated soil and waste materials exhibiting toxicity using TCLP would be treated onsite using a stabilization process. Treated soil and waste materials would be retested using TCLP to ensure that it does not exhibit unacceptable toxicity and meets RCRA Land Disposal Restriction requirements. Treated soil and waste materials not exhibiting toxicity would be transported in accordance with RCRA requirements to an approved RCRA Subtitle D landfill.

Prior to excavation of contaminated soil on the Abex Lot, the McCready Lot, and the Holland Property, existing asphalt and concrete would be removed and disposed of as construction and demolition debris. This alternative is based on Alternative III Case 2 in the FS and additional information developed in response to public comments. Estimated Capital Cost:

$28,891,243 Estimated O & M Cost: $ 0
Present Worth: $28,891,243
Time to Construct: 55 weeks

Alternative 5: Surface and Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal, Capping, Institutional Controls

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated, treated, and disposed of as described under Alternative 4, with the exception of the Holland Property, the Abex Lot, and the McCready Lot, which would be permanently capped with asphalt in accordance with RCRA Subtitle C requirements.

Operation and maintenance, institutional land use controls, and groundwater monitoring in accordance with RCRA requirements, would be necessary for areas that have been capped. A CERCLA five-year review would be required under this alternative because this remedy will leave hazardous substances on Site. This alternative is identified as Alternative V, Case 2 in the FS and additional information developed in response to public comments.

Estimated Capital Cost:	$ 22,074,430
Estimated O & M Cost:	$ 23,500

Present Worth:	$ 22,097,930
Time to Construct:	44 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 6: Surface and Subsurface Soil Excavation, Onsite and In-Situ Treatment, Offsite Disposal, Capping, Institutional Controls

Under this alternative, contaminated surface and subsurface soil in residential and non-residential areas would be excavated treated, and disposed of as described under Alternative 4, with the exception of the Holland Property, the Abex Lot, and the McCready Lot, which would be treated in-situ (in place) to immobilize the lead in the soil and waste material.

The in-situ treatment process utilizes augers and mixing paddles to facilitate the injection and mixing of stabilizing agents into subsurface soils. Upon completion of this process, lead within the soil and waste material is expected to be stabilized. Pilot-scale treatability studies would be required to confirm the effectiveness of the in-situ treatment system.

Prior to the in-situ treatment, existing asphalt and concrete on the Abex Lot, McCready Lot and Holland Property would be removed and disposed of as construction and demolition debris. After the treatment is complete, these areas would capped in accordance with RCRA requirements. Operation and maintenance, institutional land use controls, and groundwater monitoring in accordance with RCRA requirements, would be necessary for areas that have been treated in-situ and capped. A CERCLA five-year review would be required. This alternative is identified as Alternative VII, Case 2, in the FS and additional information developed in response to public comments.

Estimated Capital Cost:	$ 23,654,430
Estimated O & M Cost:	$ 23,500
Present Worth:	$ 23,677,930
Time to Construct:	45 weeks

(Note: O & M costs are presented for a 30-year period. Since maintenance on capped areas would need to continue beyond 30 years, O & M costs would actually exceed this amount.)

Alternative 7: Surface and Limited Subsurface Soil Excavation, Onsite Treatment, Offsite Disposal, Institutional Controls

Under this alternative, soil exceeding 500 mg/kg lead would be excavated from the surface to a depth of two feet. Subsurface soils below two feet with lead levels above 5,000 mg/kg would be excavated to the depth of the water table. Soil with lead levels between 500 and 5,000 mg/kg lead would remain below a depth of two feet. All excavated soil would be handled asdescribed under Alternative 4.

Institutional land use controls preventing any disturbance of soil below two feet would be required in areas where lead concentrations in subsurface soil exceed 500 mg/kg[5]. <Footnote>5 Institutional controls were not included in Alternative 7 in the Proposed Plan. Upon further consideration, EPA and VDWM have determined that institutional controls would be necessary for Alternative 7 to be protective of human health and the environment. Section XI (Documentation of Significant Changes) provides further discussion.</footnote> These controls would be necessary to prevent exposure to contaminated subsurface soil left in place and to ensure that surface soils are not recontaminated as a result of future construction activities. Activities that could be restricted to prevent recontamination of surface soil include, but are not limited to, construction of housing additions, maintenance, addition/replacement of subsurface utilities, demolition of exiting buildings/structures, construction of new buildings/structures and construction of in-ground pools.

A CERCLA five-year review would be required under this alternative because this remedy will leave hazardous substances on Site.

Estimated Capital Cost:	$ 16,169,450
Estimated O & M Cost:	0
Present Worth:	$ 16,169,450
Time to Construct:	40 weeks

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA has developed a process to analyze remedial alternatives based on the statutory requirements of Section 121 of CERCLA, 42 U.S.C. 9621, and site-specific experience gained in the Superfund program. This process uses nine criteria as set forth in the NCP, 40 C.F.R. Section 300.430(e)(9)(iii), which encompass statutory requirements and technical, cost, and institutional considerations that EPA has determined are appropriate for a thorough evaluation. The nine criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Brief descriptions of each of these criteria by category are presented below.

THRESHOLD CRITERIA: (relates to statutory requirements that each alternative must satisfy in order to be eligible for selection)

(1) Overall Protection of Human Health and the Environment:

Evaluation of the ability of each alternative to provide adequate protection of human health and the environment in the long and short-term; description of how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

(2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):

Evaluation of the ability of each alternative to meet all ARARs of Federal and State environmental laws and/or justification for invoking a waiver; assessment of the ability of each alternative to comply with advisories, criteria, and guidance that EPA and VDWM have agreed to follow.

PRIMARY BALANCING CRITERIA: (technical criteria upon which the detailed analysis is primarily based)

(3) Long-term Effectiveness and Permanence:

Evaluation of expected residual risk and the ability of each remedy to maintain reliable protection of human health and the environment over time after cleanup goals have been met.

(4) Reduction of Toxicity, Mobility, or Volume through Treatment:

Evaluation of the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances.

(5) Short-term Effectiveness:

Evaluation of the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

(6) Implementability:

Evaluation of the technical and administrative feasibility of each alternative, including the availability of materials and services.

(7) Cost:

Estimation of capital, O & M, and net present worth costs for each alternative.

MODIFYING CRITERIA: (criteria considered throughout the development of the preferred remedial alternative and formally assessed after the public comment period, which may modify to preferred alternative)

(8) State/Support Agency Acceptance:

Assessment of technical and administrative issues and concerns that the State may have regarding each alternative.

(9) Community Acceptance:

Assessment of issues and concerns the public may have regarding each alternative based on a review of public comments received on the Administrative Record and the Proposed Plan.

The alternatives were evaluated and compared in the FS and/or the Proposed Plan based on these nine criteria. This section summarizes EPA's comparison of alternatives based on the previous analyses with consideration of certain clarifications and modifications to some of the alternatives resulting from input received during the public comment process. Table 9 provides an overview of the comparison of alternatives.

Overall Protection of Human Health and the Environment

Although surface soil (0-12" in depth) contamination in the Washington Park Housing Project and the Effingham Playground has been addressed under the 1992 removal action, lead levels in the surface soil in the Effingham residential area presently exceed the residential health-based cleanup level of 500 mg/kg; surface soil on the Holland Property and in the vacant lots also exceeds 500 mg/kg lead; subsurface soil (> 12" in depth) in the residential areas including the Washington Park Housing Project, the Effingham residential area, and the Seventh Street row homes, exceeds the health-based cleanup level of 500 mg/kg; subsurface soil in the non-residential areas including the Holland Property, the Abex Lot, the McCready Lot, the drug rehabilitation center, and the vacant lots exceed 1,000 mg/kg lead. Alternative 1 (No Action) would not prevent current and/or future exposure to lead contaminated soil at the Abex Site and is not protective of human health. Therefore, Alternative 1 will not be considered further as a remedial alternative.

Alternative 2 provides a remedy for surface soil (0-12" in depth) within OU1 that exceeds 500 mg/kg lead by excavating and removing these soils. However, Alternative 2 does not excavate and remove subsurface soil (> 12" in depth) within OU1 with lead levels greater than 500 mg/kg. Exposure to subsurface soil exceeding 500 mg/kg lead in residential areas or 1,000 mg/kg lead in non-residential areas either directly or after contaminated soil has been reintroduced to the surface over time would result in an unacceptable human health risk. Routine activities by property owners or their children that could result in direct contact with subsurface soil include, but are not limited to, gardening of fruits, vegetables and other plants, children playing in soil (e.g. digging holes, making mudpies, etc.), and installing fence posts, decks, and playground equipment. Construction activities thatcould result in human exposure to contaminated subsurface soil and there contamination of surface soil include, but are not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of inground pools.

Alternative 2 includes capping and institutional controls to control human exposure to soil exceeding 500 mg/kg during routine activities and construction activities. EPA and VDWM do not support the use of restrictions on residential property as a method to achieve protection of human health and the environment unless no other feasible alternatives are present.

Both Alternatives 3 and 4 would remove surface and subsurface soil above the water table in residential and non-residential areas to health based cleanup levels. In residential areas, surface and subsurface soil with lead exceeding 500 mg/kg lead above the water table would be removed. In the nonresidential areas, surface soil above 500 mg/kg lead and subsurface soil above 1,000 mg/kg lead would be removed to the depth of the water table. The Abex Lot is the only area where subsurface soil contamination above the cleanup level is expected to occur below the water table. The Abex Lot is zoned for commercial and/or light industrial use. Future activity is not expected to extend into the water table and quantity of soil exceeding 1,000 mg/kg lead below the water table is expected to be minimal. Alternatives 3 and 4 are both considered fully protective of human health and the environment.

Alternatives 5 and 6 would remove contaminated surface and subsurface soil in residential and non-residential areas within OU1 as described above for Alternatives 3 and 4, with the exception of soil within the Holland Property, the Abex Lot, and the McCready Lot. These areas would be permanently capped with asphalt under Alternative 5, and treated in-situ and then capped with asphalt in Alternative 6. Institutional controls would be required to assure permanent maintenance of the asphalt caps under both alternatives. Alternatives 5 and 6 are both considered protective of human health and the environment.

Alternative 7 would remove soil within OU1 exceeding 500 mg/kg lead between the surface and a depth of two feet. This removal would minimize unacceptable health risks associated with exposure to shallow soil during routine activities including, but not limited to, gardening of fruits, vegetables and other plants, children playing in soil (e.g. digging holes, making mudpies, etc.), and installing fence posts, decks, and playground equipment (assuming these activities do not extend beyond two feet in depth). However, under this alternative, lead levels between 500 mg/kg and 5,000 mg/kg would remain in soil below two feet in depth. As discussed in Alternative 2, construction activities could result in human exposure to contaminated subsurface soil and the recontamination of surface soil. Institutional controls would be required to restrict construction activities including, but not limited to, construction of housing additions, maintenance and addition/replacement of subsurface utilities, demolition of existing buildings/structures, construction of new buildings/structures, and construction of inground pools. As stated in Alternative 2, EPA and VDWM do not support the use of restrictions on residential property as a method to achieve protection of human health and the environment unless no other feasible alternatives are present.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The ARARs associated with Alternatives 2 - 7 are the same. Under Alternatives 2, 5, and 7, however, some soil left in place may be a RCRA Characteristic Hazardous Waste (D008) due to high levels of leachable lead. In the event that such soil is excavated during some future activity, this soil would need to be treated and disposed of in accordance with RCRA Land Disposal Restrictions.

All alternatives would be in compliance with existing Federal and State ARARs.

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time after cleanup levels have been met.

Alternative 2 would leave subsurface soil (> 12" in depth) contaminated with lead levels of up to 50,000 mg/kg in place and covered with soil and grass or asphalt within OU1, thereby resulting in the potential for a substantial residual risk.

Alternatives 3 and 4 provide minimal residual risk and, therefore, a high degree of long-term effectiveness since surface and subsurface soil that exceed 500 and 1,000 mg/kg lead in residential and non-residential areas of OU1, respectively, are excavated, treated as required, and disposed of offsite in an approved RCRA landfill.

Alternatives 5, 6, and 7 all leave contaminated soils and/or waste material in place, thereby allowing for potential residual risk. Alternatives 5 would leave soil and waste material contaminated with lead up to 58,000 mg/kg beneath asphalt caps on the Holland Property, the Abex Lot, and the McCready Lot. Alternative 6 would also leave contaminated soil and waste material in place, however, in-situ treatment would take place prior to capping and, therefore, reduce the potential residual risk. Alternative 7 would leave soil containing 500 to 5,000 mg/kg lead in place below two feet in depth within residential and non-residential areas. As with Alternative 2, Alternative 7 would result in the potential for a substantial residual risk at the Site.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Lead, the primary contaminant of concern at the Site, is a metallic element that cannot be destroyed to reduce its toxicity. Therefore, remedies addressing lead contamination in soil generally require either removal and/or stabilization by immobilizing the lead within the soil structure, thereby reducing the mobility of the contaminant. Stabilization, however, results in an increase in the volume of material to be addressed and will not reduce the toxicity of the lead.

Under Alternative 2, only surface soil (0-12" in depth) within OU1 would be excavated and treated as appropriate (i.e., in accordance with RCRA Land Disposal Restriction requirements). Contaminated soil below this level would remain in place. Contaminated soil and waste material on the Holland Property, the Abex Lot, and McCready Lot would remain in place and be in accordance with RCRA requirements. This alternative, therefore, would not significantly reduce the mobility and volume of lead through treatment.

Under Alternatives 3 and 4, surface and subsurface soil above the water table within OU1 that is contaminated above health-based cleanup levels would be excavated and treated, as appropriate, to reduce the mobility of lead in the soil. In any case where the soil is treated, the volume of the lead- contaminated soil will increase due to the addition of stabilizing agents designed to reduce lead mobility.

Under Alternative 5, contaminated surface and subsurface soil above the water table within OU1 would be excavated and treated, as appropriate, to reduce the mobility of lead in the soil, with the exception of contaminated soil and waste material within the Holland Property, the Abex Lot, and the McCready Lot. These areas would not be treated, but would be contained with one foot of asphalt. As such, Alternative 5 would fail to treat the primary sources of lead contamination at the Site.

Alternative 6 is the same as Alternative 5, except that contaminated soil and waste material on the Holland Property, the Abex Lot, and the McCready Lot would be treated in-situ before capping. While in-situ treatment may significantly reduce the mobility of lead, treatability studies would need to be performed during the Remedial Design to determine the extent of the reductionin mobility that can be achieved.

Alternative 7 would excavate and treat, as appropriate, surface and subsurface soil within OU1 that exceeds 500 mg/kg lead within two feet of the ground surface, as well as soil exceeding 5,000 mg/kg between two feet in depth and the water table. Under Alternative 7, soil between 500 and 5,000 mg/kg lead within residential areas would remain in place below two feet in depth. Therefore, Alternative 7 would not reduce the mobility of lead to the extent accomplished under Alternatives 3 and 4, and perhaps under Alternative 6.

Short-term Effectiveness

The primary short-term effects associated with each alternative are possible exposure to contaminated dust generated during excavation, and exposure to physical safety hazards that exist around heavy equipment. Airborne dust containing elevated lead levels could be generated during soil excavation required in Alternatives 2 - 7. The extent of soil excavation is highest under Alternatives 3 and 4, and lowest under Alternative 2. Additional dust could be generated during soil handling and operation of treatment units onsite, particularly under Alternatives 4 and 7. However, measures would be taken to control dust during implementation of the various alternatives. These measures would be detailed in the Remedial Action Work Plan and the associated Health and Safety Plan which must be prepared and approved by EPA and VDWM prior to initiation of construction. Measures to be performed would include (1) dust suppression during excavation, handling, and treatment activities, (2) sampling the interior of homes for contaminated dust before, during, and after remedial activities to ensure dust suppression has been effectively implemented, and (3) air monitoring for both lead and dust before and during remedial activity.

Alternatives 3 - 7 would require temporary relocation of residents during excavation of contaminated surface and subsurface soil around or beneath their home or residential unit. This action is being taken to minimize the physical safety hazards associated with heavy equipment operating in close proximity to residential property. Details on the extent of excavation required for each home or residential unit and the arrangements for temporary relocation would be discussed with impacted residents during the Remedial Design process.

Alternatives 4 - 7 require onsite treatment of excavated soils. The Remedial Action Work Plan and Health and Safety Plan to be developed would detail measures to be taken to secure the area where soil is stockpiled and treated to prevent air or water-borne releases of contaminated soil and to prevent access by local children.

Implementability

Alternatives 3, 4, 5, and 6 require extensive excavation of contaminated surface and subsurface soil including contaminated soil that may exist adjacent to foundations and/or beneath homes or residential units. Due to the unstable nature of soil or fill material around or under many of the impacted residences and the proximity of the water table to the ground surface (estimated at 3 to 6 feet), strict engineering practices would need to be followed to prevent damage to the homes during excavation. Further geotechnical investigation would be required as part of the Remedial Design to determine appropriate construction techniques to be used to maintain the structural integrity of each home or residential unit requiring excavation. While additional costs would be incurred by implementing the necessary engineering controls, current engineering technology can be employed to safely remove contaminated soil around and beneath impacted residences.

In the case of Alternatives 4, 5, 6, and 7, implementation of onsite treatment will require careful planning and additional construction activities. In each case, treatability studies will be necessary to determine the appropriate mixture of reagents needed to effectively immobilize the lead in the soil. The implementation of these alternatives will require significantly more activity onsite than Alternatives 2 and 3, where treatment would be performed offsite at an RCRA-permitted facility.

Alternative 6 includes in-situ treatment of the Holland Property, the Abex Lot, and the McCready Lot, as well as treatment of excavated soil from other areas of the Site in an above-ground onsite treatment unit. The use of two separate onsite treatment units may further increase the time necessary to complete the remediation. Extensive pilot-scale treatment studies would be necessary to confirm the effectiveness of the in-situ treatment system. As a result, Alternative 6 would likely require a significantly longer time to complete the Remedial Design than the other alternatives.

As discussed under the criteria for Overall Protection of Human Health and the Environment and Long-term Effectiveness and Permanence, Alternatives 2, 5, 6, and 7 require effective implementation of institutional controls to fully satisfy these criteria. Of these alternatives, Alternative 2 relies most heavily on the use of institutional controls. All properties with subsurface soil (> 12" in depth) that exceeds 500 mg/kg in residential areas and 1,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the one-foot depth. In terms of the residential areas, most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. EPA and VDWM prefer not to impose such restrictions on residential properties unless no other feasible alternatives are present.

Alternative 7 is second to Alternative 2 in its reliance on institutional controls to protect human health and the environment and to achieve long-term effectiveness. All properties with soil below two feet in depth that contains lead at 500 to 5,000 mg/kg in residential areas and at 1,000 to 5,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the two-foot depth. Again, most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. At the time the Proposed Plan was issued, EPA and VDWM supported this alternative as the preferred remedy. However, during the initial analysis of alternatives, EPA and VDWM had not fully considered the implications of allowing contaminated soil between 500 and 5,000 mg/kg lead to remain below two feet. EPA and VDWM also became aware during the public comment period that many homes in the Effingham residential area had crawl spaces, many of which were found to be contaminated with lead at levels exceeding 500 mg/kg. Upon further consideration, EPA and VDWM recognized that institutional controls would be required as part of this alternative. While restrictions would probably be required on fewer properties under Alternative 7 than under Alternative 2, and the restrictions on property use would be less severe, EPA and VDWM still prefer not to impose of such restrictions on residential properties unless no other feasible alternatives are present.

The institutional controls required under Alternatives 5 and 6 are limited to restrictions needed to ensure capped areas on the Holland Property, the Abex Lot, and the McCready Lot are permanently maintained. EPA and VDWM consider these institutional controls to be implementable.

Cost

Alternative 2 has the lowest total present worth cost at $4,888,930. However, long-term cap maintenance and groundwater monitoring costs would actually be higher than estimated since these activities would need to continue well beyond the 30-year period used for estimation purposes. Administrative costs associated with implementing institutional controls have not been included. In addition, this cost does not reflect the fact that use of the Holland Property, the Abex Lot, and the McCready Lot would be permanently restricted.

Alternative 7 is the second least costly remedy with a total present worth of $16,169,450. As in Alternative 2, this total does not include administrative costs that would be associated with implementing institutional and does not reflect the impact of restricting the future use of residential and non-residential properties.

Alternatives 5 and 6 are similar in total present worth cost at $22,074,430 and $23,654,430, respectively. The limitations of these cost estimates are the same as discussed for Alternative 2.

Alternative 4 is second most costly remedy with a total present worth of $28,891,243. Alternative 3 is the most costly alternative with an estimated present worth of $37,895,000. There are no annual operation and maintenance costs or administrative costs for implementing institutional controls associated with either of these alternatives.

State Acceptance

VDWM served as the lead agency for the Abex Site during implementation of the RI/FS. VDWM has reviewed the remedial alternatives under consideration for the Abex Site and has provided EPA with technical and administrative requirements for the Commonwealth of Virginia. VDWM agrees with the analysis of alternatives presented in this ROD and concurs with EPA's selected remedy discussed below.

Community Acceptance

During the public comment period, the community expressed a strong desire to have a remedy that guarantees protection of human health and the environment in a manner that does not restrict their activities in the future. Many of the comments EPA and VDWM received from local residents expressed the concern that none of the alternatives being considered would restore their community to a safe level and they, therefore, preferred to be permanently relocated. Since EPA, in consultation with VDWM, has determined that Alternatives 3 and 4 would achieve the desire of local residents for a remedy that restores their community to a safe level without restricting their future activities, EPA is not recommending permanent relocation. EPA has included temporary relocation in the alternatives requiring excavation of contaminated surface and subsurface soil in residential areas. This measure will minimize the physical safety hazards associated with heavy equipment operating in close proximity to residential property.

IX. SELECTED REMEDY AND PERFORMANCE STANDARDS

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives presented in the Proposed Plan using the nine criteria, and public comments, EPA, in consultation with VDWM, has determined that Alternative 4 is the most appropriate remedy for the Abex Superfund Site. The major components of the remedy and the required performance standards are listed below. Table 10 provides a detailed cost estimate for Alternative 4.

SOIL EXCAVATION

Performance Standards:

- Soil in residential areas within OU1, including the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, and the Effingham Playground, where lead concentrations exceed 500 mg/kg shall be excavated; excavation shall extend to the depth of the water table and, to the extent practicable, shall be performed when the water table is at the seasonally low elevation.

- Contaminated soil exceeding 500 mg/kg lead around the foundations and beneath homes and residential units within OU1 shall be excavated; the structural integrity of each home or residential unit shall be maintained by performing geotechnical investigations during the Remedial Design to determine the appropriate construction measures to be taken during excavation.

- Soil from non-residential areas within OU1, including soil currently covered with material such as asphalt or concrete (i.e., the Holland Property, the Abex Lot, the McCready Lot, and the drug rehabilitation center) where lead concentrations either exceed 500 mg/kg at the surface (0-12" in depth) or exceed 1,000 mg/kg in the subsurface (> 12") shall be excavated; excavation of subsurface soil shall extend to the depth of the water table and, to the extent practicable, shall be performed when the water table is at the seasonally low elevation; asphalt, concrete, and other similar material that cover soil contaminated with lead above the cleanup levels shall be removed prior to excavation.

Additional Components:

- Residents shall be temporarily relocated while surface and subsurface soil is excavated around and/or beneath their particular home or residential unit; dust suppression measures shall be used to prevent contaminated dust from entering homes or adjacent areas; sampling of the interior of homes shall be performed before, during, and after excavation to ensure dust control measures have been effective; air monitoring for lead and dust shall be performed inaccordance with 40 C.F.R. Part 50, Appendix G, to ensure air emissions conform with the National Primary and Secondary Ambient Air Quality Standards for lead, 40 C.F.R. S 50.12, and particulate matter, 40 C.F.R. S 50.6, and for the control of fugitive dust emissions in accordance with Virginia Air Pollution Control Board Regulations, VR 04-0101.

. Erosion and sediment control measures shall be installed in accordance with the substantive requirements of the Virginia Erosion and Sediment Control Law, Code of Virginia S 10.1-560 et seq., the Virginia Erosion and Sediment Regulations, VR 625-02-00, and the City of Portsmouth's Erosion and Sediment Control Ordinance; an erosion and sediment control plan shall be prepared and submitted for review.

. All excavated areas shall be backfilled with clean fill; areas vegetated prior to excavation shall be restored to original conditions to the extent practicable.

. Additional sampling and analysis of soil shall be performed prior to excavation to determine the full extent of contamination. Sampling and analysis shall also be performed after excavation has been completed to confirm that cleanup goals set forth in the performance standards have been achieved; methods for determining that the cleanup goals have been reached shall be finalized during the Remedial Design and approved by EPA and VDWM based on EPA 230/02-89-042, Methods for Evaluating the Attainment of Cleanup Standards, Vol I.

. Excavated soil and waste materials shall be temporarily staged onsite prior to treatment and/or transportation to an offsite disposal facility; to the extent practicable, excavated soil and waste material shall be staged in areas of existing contamination, preferably on the Abex Lot, the Holland Property, and the McCready Lot;measures such as berms and temporary covers shall be used in areas with staged material to ensure that there are no unacceptable air or waterborne releases of contamination from these areas; these measures shall be sufficient to provide protection in the event of flooding; areas that are used to stage excavated material shall be secured with a fence to prevent trespassing.

. When the final areas of contamination are being addressed at the Site, excavated soil and waste materials may need to be staged in an area where cleanup has previously occurred. In all instances where soil and waste materials are staged in areas where cleanup has previously occurred or are otherwise not contaminated above levels requiring excavation, soil and waste material shall be staged in containers in accordance with RCRA regulations contained in 40 C.F.R. Part 268.50; containers used shall be in compliance with VHWMR Section 10.8 Use and Management of Containers.

SOIL TREATMENT AND DISPOSAL

Performance Standards:

. Excavated soil and waste materials shall be tested using TCLP to determine if they exhibit toxicity as defined in 40 C.F.R. Part 261, Subpart C; contaminated soil that does not exhibit toxicity during testing shall be disposed of offsite at an approved RCRA Subtitle D landfill.

. Soil and waste material that exhibits toxicity due to the leaching of lead or other metals of concern shall be handled as a RCRA Characteristic Waste as defined in 40 C.F.R. Part 261, Subpart C. Such material shall be treated prior to disposal using a stabilization process that mixes the excavated soil and waste materialswith chemicals/reagents to create a final product that encapsulates and immobilizes the lead and other metals; specific chemicals to be used in the process shall be determined in a treatability study during the

Remedial Design phase of this project; mixing shall be contained in above-ground equipment onsite in accordance with VHWMR Section 10.9, Tanks.

- Treated material shall be tested using TCLP to ensure it no longer exhibits toxic characteristics; treated material that continues to exhibit toxicity shall either be subject to additional treatment to further reduce toxicity, or disposed of offsite in an approved RCRA Subtitle C landfill if RCRA Land Disposal Restriction requirements have been met; treated material that no longer exhibits toxicity using TCLP shall be disposed of offsite in an approved RCRA Subtitle D landfill; if a disposal facility in Virginia is used, the treated waste is considered a "Special Waste" under Part VIII of VSWMR and specific approval from VDWM's Director shall be obtained prior to disposal.

Additional Components:

- Air monitoring for lead and dust shall be performed in accordance with 40 C.F.R. Part 50, Appendix G, to ensure air emissions conform with the National Primary and Secondary Ambient Air Quality Standards for lead, 40 C.F.R. S 50.12, and particulate matter, 40 C.F.R. S 50.6, and for the control of fugitive dust emissions in accordance with Virginia

  Air Pollution Control Board Regulations, VR 04-0101.

- The onsite treatment unit shall be housed in a temporary structure to minimize exposure to the elements and the opportunity for air or water-borne releases.

- Treated material shall be staged onsite in accordance with the same requirements described above for staging untreated excavated soil and waste materials.

- Any transportation of hazardous waste from the Site shall be performed in accordance with VHWMR Part VII, Regulations Applicable to Transporters of Hazardous Waste, and RCRA requirements as defined in 40 C.F.R. Parts 262 and 263, and 49 C.F.R. Parts 107, and 171 - 179; any local roads damaged by the increased truck traffic associated with the remedial action shall be repaired in a timely manner following the conclusion of the onsite activity.

- Any offsite discharge of water generated from the onsite soil treatment system or from site decontamination activities shall be in compliance with the Virginia Surface Water Standards and the Virginia Pollution Discharge Elimination System (VPDES) requirements; any disposal of wastewater at a local Publicly-Owned Treatment Works (POTW) shall be in compliance with the POTW's VPDES permit and pretreatment standards or requirements.

- Any treatment and/or storage units used during the remedial action (i.e., tanks or containers for storage or treatment) that are regulated under VHWMR/RCRA requirements shall meet the closure and post-closure care requirements of VHWMR Section 9.6.

BUILDING DEMOLITION

Performance Standard:

- All existing structures on the Holland Property associated with the former foundry operations shall be demolished; debris exhibiting toxicity using TCLP shall be decontaminated in accordance with RCRA Land Disposal Restriction requirements effective at the time when demolition occurs; debris shall be disposed of in an approved RCRA landfill.

Additional Components:

- Equipment stored by the current owner shall be sampled to determine if is contaminated; if analytical results find contamination, the equipment shall be decontaminated prior to removal from the Site.

X. STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. 9621, establishes several other statutory requirements and preferences. Under this Section, the selected remedy for the Site, when completed, must comply with ARARs established under Federal and State laws unless a statutory waiver is justified. The selected remedy must also be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of contamination as their principle element. This section discusses how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The baseline risk assessment for the Abex Site determined that the Site currently presents unacceptable risks to residents through exposure to contaminated soil and would pose unacceptable risks to workers exposed to contamination in the former foundry building. The risk assessment, through use of the UBK Model, indicates that average lead concentrations exceeding 400 mg/kg present an unacceptable risk to children. Average lead concentrations in surface soil exceed this level in the Effingham residential area, on the Holland Property, and in the vacant lots. Average lead concentrations also exceed 400 mg/kg in subsurface soil in the Washington Park Housing Project, the Effingham residential area, the Seventh Street row homes, the Holland Property, the Abex Lot, the drug rehabilitation center, and the vacant lots.

The baseline risk assessment also indicates that children between the ages of one and seven and future workers at the former foundry building would beexposed to unacceptable risks associated with other noncarcinogenic contaminants of concern, including copper, antimony, tin, zinc, nickel, cadmium, chromium, PAHs, and PCBs. The total lifetime cancer risks associated with the Site are 3.0×10^{-5} for residents (i.e., one additional incident of cancer in an exposed population of 33,333) and 8.97×10^{-4} for future workers at the former foundry facility (i.e., one additional incident of cancer in an exposed population of 1,115).

Excavation, treatment, and offsite disposal of contaminated surface and subsurface soil at the Site and demolition of the former foundry buildings will virtually eliminate exposure to all contaminants of concern at the Site. By removing surface and subsurface soil contaminated above 500 mg/kg lead in the residential areas, EPA and VDWM expect the average lead concentration in the soil to be in the range of 100 to 300 mg/kg. This is below the average soil concentration of 400 mg/kg, which the UBK Model estimates as the acceptable level for children. The risks associated with the other contaminants of concern will be within acceptable ranges as well through implementation of this remedy.

The short-term threats associated with the selected remedy can and will be readily controlled and no adverse cross-media impacts are expected from the remedy.

Compliance With Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Materials (TBCs)

Under Section 121(d) of CERCLA, 42 U.S.C. S 9621(d), and EPA guidance, remedial actions at Superfund sites must attain legally applicable or relevant and appropriate Federal and state environmental standards, requirements, criteria, and limitations (collectively referred to as ARARs). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address hazardous material found at the site, the remedial action to be implemented at the site, the location of the site, or other circumstances at the site. Relevant and appropriate requirements are those which, while not applicable to the site, nevertheless address problems or situations sufficiently similar to those encountered at the site that their use is well suited to that site.

The selected remedy will comply with ARARs and To Be Considered Materials (TBCs). The ARARs and TBCs are presented below.

CHEMICAL-SPECIFIC ARARs

- The Resource Conservation and Recovery Act, 42 U.S.C. SS 6901 et. seq. (40 C.F.R. Parts 261-270), the Virginia Waste Management Act, Code of Virginia S 10.1-1400 et seq., the Virginia Waste Management Regulations (VHWMR), VR 672-10-1, and the Virginia Solid Waste Management Regulations (VSWMR), VR 672-20-10 regulate the generation, transportation, treatment, storage, and disposal of hazardous wastes. Based on TCLP testing, some of the soil found during the RI exhibits toxicity for lead and would be regulated as a RCRA characteristic hazardous waste (40 C.F.R. Part 261, Subpart C and VHWMR Part III). As a result, RCRA and VHWMR are applicable to the treatment, transportation, and disposal of these soils.

- Clean Water Act, 31 U.S.C. SS1251 et seq. (National Pollution Discharge Elimination System requirements, 40 C.F.R. Part 122), the Virginia State Water control Law, Code of Virginia S 62.1-44.2 et seq., the Virginia State Water Control Board regulations, Water Quality Standards, VR 680-21-00, the Virginia Pollutant Discharge Elimination System (VPDES) and Virginia Pollution Abatement (VPA) Permit Program, VR 680-14-01, and the Virginia water Protection Permit, VR 680-15-02 regulate any discharge of wastewater to waters of the Commonwealth of Virginia.

- National Primary and Secondary Ambient Air Quality Standards for Lead (40 C.F.R. Part 50.12), and for Particulate Matter (40 C.F.R. Part 50.6), the Virginia Air Pollution Control Board, Code of Virginia S 10.1-1300 et seq., and the Virginia Department of Air Pollution Control regulations for the Control and Abatement of Air Pollution, VR 120-01-01 regulate air emissions and establish permissible levels of lead and particulate matter that can be released into the environment.

LOCATION-SPECIFIC ARARs

- Executive Order 11988, Floodplain Management, the National Flood Insurance Act of 1968, the Flood Disaster Act of 1973, and Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act regulate activities that take place in floodplains. The Site is located within a 500-year floodplain for the South Branch, Elizabeth River.

- Coastal Zone Management Act; the Coastal Management Plan for the City of Portsmouth; and the National Oceanic and Atmospheric Administration (NOAA) Regulations on Federal Consistency With Approved State Coastal Zone Management Programs regulate activities that takeplace in coastal areas. The Site lies within the Coastal Management Zone of the City of Portsmouth.

- Chesapeake Bay Preservation Act, Code of Virginia S 10.12100 and the Chesapeake Bay Preservation Area Designation and Management Regulations (CBPA Regulations), VR 173-02-01 regulate activities that take place in the Chesapeake Bay area. The City of Portsmouth Planning Department has designated the area in which the Site lies as a Resource Management Area of a Chesapeake Bay Preservation Area.

ACTION-SPECIFIC ARARs

- Virginia Erosion and Sediment Control Law, Code of Virginia S 10.1-560 et seq., and the Virginia Erosion and Sediment Control Regulations, VR 625-02-00 requires control measures during earth-moving activities to prevent erosion and transport of sediment in surface water runoff.

- 40 C.F.R. Part 50, Appendix G establishes protocols for air monitoring.

- 40 C.F.R. Part 264, Subpart I, and VHWMR Section 10.8 Use and Management of Containers regulate the use of containers for storing and/or treating hazardous wastes.

- 40 C.F.R. Part 264, Subpart J, and VHWMR Section 10.9, Tanks regulate the use of tanks for storing and/or treating hazardous wastes.

- 40 C.F.R. Parts 262 and 263, 49 C.F.R. Parts 171-179, and VHWMR Part VII, Regulations Applicable to Transporters of Hazardous Waste regulate transportation of hazardous wastes in the Commonwealth of Virginia.

- Virginia Solid Waste Management Regulations (VSWMR) Part VIII, VR 672-10-1 regulates disposal of "Special Wastes" in Commonwealth of Virginia RCRA Subtitle D solid waste landfills. Treated soil that no longer exhibits toxic characteristics would be a special waste.

- Occupational Safety and Health Administration Act (29 C.F.R. Parts 1910, 1926, and 1904) regulates health and safety in the work place.

Criteria, Advisories, or Guidance To Be Considered (TBCs):

- Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (EPA OSWER Directive 9355.4-02) recommends use of the UBK Model and appropriate assumptions to develop soil cleanup levels for lead.

- Methods for Evaluating the Attainment of Cleanup Standards, Vol. I (EPA 230/02-89-042) recommends statistical methods to confirm soil cleanup levels have been achieved.

Cost Effectiveness

EPA and VDWM considered less expensive alternatives during the remedy selection process, however, these alternatives did not provide the level of protection of human health, long-term effectiveness, reduction in mobility of contamination through treatment, or community acceptance that was provided by the selected remedy, Alternative 4. EPA and VDWM believe the selected remedy will eliminate unacceptable risks to human health at the Site at an estimated cost of $28,891,243 and, therefore, provides an overall benefit proportionate to its costs. The selected remedy also assures, with a much higher degree of certainty, that the remedy will be effective in the long-term because contaminated surface and subsurface soil in both residential and non-residential areas within OU1 will be excavated, treated as appropriate, and disposed of offsite.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

Section 121(b) of CERCLA, 42 U.S.C. S 9621(b), establishes a preference for remedial actions that permanently and significantly reduce toxicity, mobility, or volume of hazardous substances over remedial actions which will not. EPA, in consultation with VDWM, has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner to control contamination at the Abex Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA, in consultation with VDWM, has determined that this selected remedy, Alternative 4, provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost, while also considering the statutory preference for treatment as a principal element, and state and community acceptance.

The selected remedy treats lead-contaminated soil that exhibits toxicity, as determined using TCLP, thereby achieving significant reduction of the mobility of lead in soil. Alternatives 3 and 4 provide the most effective treatment of any of the alternatives considered, with Alternative 4 being the most cost effective. The selection of treatment of the contaminated soil is consistent with program expectations that indicate that highly toxic wastes are a priority for treatment and often necessary to ensure the long-term effectiveness of a remedy.

Preference for Treatment as Principal Element

By treating the contaminated soil at the Site that exhibits toxicity using TCLP, the selected remedy addresses the principal threats posed by the Site through the use of treatment technologies and satisfies the statutory preference for remedies that employ treatment as a principal element.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan, released for public comment on April 28, 1992, identified Alternative 7 as the preferred alternative of VDWM and EPA. At that time, EPA and VDWM had not fully considered the implications of Alternative 7 with respect to allowing contaminated soil between 500 and 5,000 mg/kg lead to remain at depths below two feet in both residential and non-residential areas. During the public comment period, EPA and VDWM recognized that institutional controls would be required as part of this alternative. All properties with soil contaminated below two feet in depth at levels of 500 to 5,000 mg/kg in residential areas and at 1,000 to 5,000 mg/kg in non-residential areas would require restrictions to limit activities that may occur below the two-foot depth. These restrictions would significantly impact the current residential areas. Most of the privately-owned homes in the Effingham residential area, several of the units in the Washington Park Housing Project, and several of the Seventh Street row homes would be subject to these restrictions. EPA, in consultation with VDWM, decided to select a remedy that includes excavation of contaminated soil below two feet (Alternative 4) rather than one that would impose restrictions on residential properties (Alternative 7). Section VIII (Summary of Comparative Analysis of Alternatives) of the ROD presents the full evaluation of the all alternatives based on the nine criteria identified in the NCP and provides the basis for the selection of Alternative 4.

Several additional changes and clarifications were made to the Common Elements associated with the alternatives after considering comments received during the public comment period. In the Proposed Plan, the former foundry facility was to be decontaminated. Based on comments received and further review of the condition of the former foundry building, and several associated structures, the ROD requires demolition.

Several residents raised questions about contamination in crawl spaces beneath their homes during the public comment period. Sampling performed as part of the recent removal action confirmed that lead contamination above 500 mg/kg exists beneath many of the homes. The ROD clarifies that excavation of contaminated soil adjacent to foundations and beneath homes is required as part of alternatives that include excavation of contaminated subsurface soil.

Due to the extent of excavation that may be required around and beneath homes and residential units, and in response to concerns raised by many local residents, temporary relocation was added as a Common Element for all alternatives requiring subsurface soil excavation. Temporary relocation would be provided to residents while excavation is occurring around and/or beneath their home or residential unit.

A final change made to the alternatives requiring subsurface excavation (> 12" in depth) in non-residential areas is a change in the lead cleanup level from 500 mg/kg to 1,000 mg/kg. This change was made: (1) to reflect the fact that nearby residents are not expected to be exposed to subsurface soil in the non-residential areas to the same extent they would be exposed in residential areas and (2) to be consistent with the lead cleanup levels used at other Superfund site for non-residential land use.